HELSINKI UNIVERSITY OF TECHNOLOGY
Department of Electrical and Communications Engineering
Telecommunications Software and Multimedia Laboratory

Mikael Bärlund

Usability Study of Shift Logbooks in Physics Experiments at CERN

Master's Thesis
November 26, 2008

Supervisor: Professor Tapio Takala

Instructor: PhD. Francois Grey, CERN

HELSINKI UNIVERSITY OF TECHNOLOGY	ABSTRACT OF THE MASTER'S THESIS

Author:	Mikael Bärlund		
Name of the thesis:	Usability Study of Shift Logbooks in Physics Experiments at CERN		
Date:	November 26, 2008	**Number of pages:**	68
Department:	Electrical and Communications Engineering	**Professorship:**	T-111
Supervisor:	Professor Tapio Takala		
Instructor:	PhD. Francois Grey, CERN		

Scientific experiments conducted at CERN are vast collaborations often concerning scientists scattered around the world. Measures have been taken for distributing the data gathered by the detectors such as ATLAS and ALICE. But not only the detector data is needed to understand what triggered the event. Entries into the logbooks used by scientists running the accelerators and monitoring the detectors are also of importance. Traditionally scientists made entries into paper logbooks regarding changes into the the setup of the experiment. Problems and solutions to them were other common entries. The paper logbook is a natural and easy to use interface for making entries. Problems arise when there is need to search logbooks and share them with a large community. Electronic logbooks make it possible to search and share logbooks. Therefore most large experiments have adopted some sort of electronic logbook. How well has the transition from paper to electronic logbooks been adopted? Does the usability of these electronic logbooks answer the needs of scientists? Do the applications offer the functionality needed by the scientists?

A contextual design study was made into the use of logbooks within CERN control center (CCC) and ATLAS. This was done in order to get a better understanding about how scientists use their electronic and paper logbooks and to discover what shortcomings the electronic logbooks have compared to the paper logbook. Some new functionality that would be worth incorporating into the logbook was found, including guidance for better entries and free-form entries. The usability of the CCC eLogbook interface was evaluated. A usability evaluation of the user interface was conducted. The study revealed a set of problems and a proposal for improvement was given.

The study shows that most electronic logbook used today are in-house developed applications which have an air of ad-hoc development around them. They claim to take usability into account. Still, the user-interfaces are sometimes cumbersome and lack certain functionality. Therefore paper logbook are still frequently used, mainly for personal notes. However these personal notes include calculations, problem solving, etc. which formerly was entered into official paper logbooks. This results in a coarser record of events in the electronic logbooks compared to paper logbooks.

Keywords: Contextual Design, Usability Evaluation, Electronic Logbook, CCC eLogbook, ATLOG

TEKNISKA HÖGSKOLAN		SAMMANDRAG AV DIPLOMARBETE

Utfört av:	Mikael Bärlund	
Arbetets namn:	Användarvänlighetsundersökning av shiftloggböcker använda inom fysikaliska experiment i CERN	
Datum:	26 november 2008	**Sidor:** 68
Avdelning:	Fakulteten fr elektronik, kommunikation och automation	**Professur:** T-111
Examinator:	Professori Tapio Takala	
Handledare:	FT Francois Grey, CERN	

Vetenskapliga experiment som utförs vid CERN är samarbeten som ofta omfattar forskare runtom i världen. Åtgärder har vidtagits för att fördela data som genereras av detektorer såsom ATLAS och ALICE. Men inte bara data från detektorerna behvös för att förstå vad som utlöste en specifik händelse. Noteringar i loggböcker om installningar och problem med acceleratorerna är ocksåav betydelse. Traditionellt gjorde forskarna anteckningar i papper loggbcöker om allting som hänför sig med experimentet. Problem och lösningar var allmänna anteckningar. Papper loggböcker är ett naturligt och lättanvänt gränssnitt för att göra anteckningar. Problem uppstår när det finns behov av att söka bland många loggböcker och distribuera dem till en större grupp. Elektroniska loggböcker göra det möjligt att enkelt söka i och distribuera loggböckernas innehåll. Därför har många stora experiment övergått till någon form av elektronisk loggbok. Men hur har övergången från papper till elektroniska loggböcker antagits? Motsvarar användbarheten av dessa elektroniska loggböcker vetenskapsmännens behov? Erbjuder loggböckerna den funktionalitet som krävs?

En kontextuell undersökning gjordes om användningen av loggböcker i CERN Contol Center (CCC) och ATLAS. Detta gjordes för att få bättre insikt om hur forskare använder sina elektroniska och papper loggbcker och för att upptäcka vilka brister elektroniska loggböcker har jämfört med papper. Ny funktionalitet som skulle vara värd att integrera hittades, bland annat handledning för bättre inlägg och möjlighet att gjöra hand-skrivna inlägg. CCC eLogbook loggbokens användargränssnitts användbarhet utvärderades. Studien visade en rad problem och förslag till förbättringar gjordes.

Studien visar att många elektroniska loggböcker som används idag är applikationer utvecklade internt inom företaget. De hävdar att ta användbarhet i beaktande. Ändå är andvändarrgränssnitten ibland besvärliga och saknar viss nödvändig funktionalitet. Därför används traditionella loggböcker fortfarande ofta, dock huvudsakligen för personliga anteckningar. Men dessa personliga anteckningar innehåller beräkningar, problemlösning med mera, som tidigare var inlägg i officiella loggbcker. Detta ger ett resultat med endast grövre innehåll i de elekroniska loggböckerna jämfört med traditionella loggböcker.

Nyckelord: Contextual Design, användbarhetstestning, elekronisk loggbok, CCC eLogbook, ATLOG

Acknowledgements

This thesis was made as part of the collaboration between Helsinki Istitute of Physics and OpenLab in CERN, Geneva.

I would like to thank professor Tapio Takala for his guidance on the way to completing this thesis. I would also like to thank my instructor Francois Grey for his invaluable help.

I am grateful to my colleagues in HIP-tek, CERN for their support and constructive criticism.

Special thanks to my parents and Aino for believing in me through the years.

26 november 2008 in Otaniemi, Finland

Mikael Bärlund

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Abbreviations

Alcator	**Al**to **Ca**mpo **Tor**us
ATLAS	**A T**orroida**l A**pparatu**s**
ATLOG	ATLAS Logbook
CCC	CERN Control Center
CD	Contextual Design
CERN	European Organisation for Nuclear Research
ELOG	Electronic Logbook developed in Paul Scherrer Institut
ISO	International Standardisation Organisation
LHC	Large Hadronic Collider
PS	Proton Synchrotron
SPS	Super Proton Synchrotron
TI	Technical Infrastructure

1 Introduction

Scientists and engineers traditionally kept paper logbooks of their experiments and inventions. The need for the logbook is self explanatory. Scientists need to keep a record of their doings in order to remember and report what has been done. The logbook also gives a mean of retracing past experiments and verifying their accountability. Searching logbooks can also determine who was the first to make a new discovery or invention. In the USA the first to invent rule is used for patents and a properly kept logbook is crucial for proving an idea is yours [1].

In less than twenty years the habits of logbook use has changed radically. Even though some scientists still solely use old fashioned paper logbooks many large scientific collaborations are already using electronic logbooks. [2, 3, 4, 5, 6]

The European Organisation for Nuclear Research (CERN) is currently the world's largest particle physics centre [7]. CERN Control Center (CCC) combines the control of CERNs eight accelerators. An electronic logbook, called eLogbook, has been developed for use in CCC and experiments related to the CCC controlled accelerators. The eLogbook is currently being used to log events about accelerators such as the Proton Synchrotron (PS), Super Proton Synchrotron (SPS) and the Large Hadron Collider (LHC). With the experiments done in CERN it is crucial to share information to a large community. Not only data gathered by the detectors, but also the information in scientists' logbooks about adjustments to the

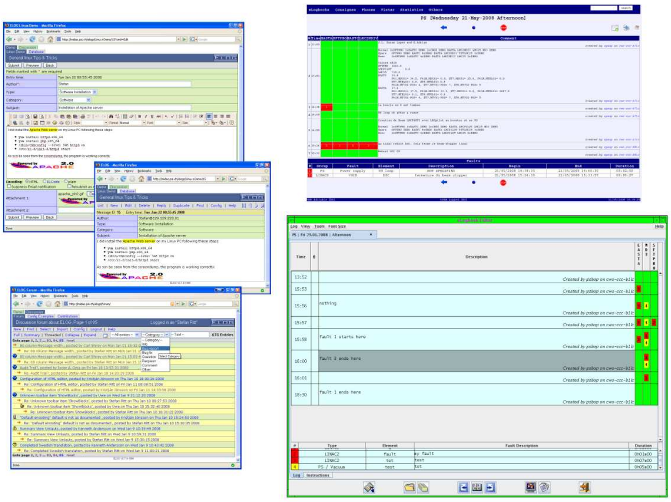

Figure 1.1: Electronic logbooks used at CERN

machines are of interest to scientists following the experiments. Some electronic logbooks currently used in CERN experiments are illustrated in Figure 1.1.

The oldest electronic logbooks used in CERN have been around for more then 10 years now. Some experiments have completely moved from paper logbooks to electronic ones. Some experiment managers actively disencourage the use of paper logbooks. Some of the smaller projects still solely use paper logbooks. Problems arise when the interface of the electronic logbook is more cumbersome then the good old paper and pen. In an environment where use of paper is disencouraged this can lead to important notes and sketches never being entered and recorded into the official logbook. They just end up as scribbles on pieces of paper which are later thrown away.

Usability is a term referring to the interaction of users with a system. It is often measured in terms of how easy to learn and use the system and whether users are pleased with using the system or not. The ISO 9241-11:1998 standard defines usability as “It is the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". [8]

This thesis is a study into the usability of shift logbooks used in large scientific experiments, especially in CERN. The objectives of this thesis is to evaluate the current state of usability of the CCC eLogbook and also get a wider understanding of the usability of currently available electronic shift logbooks. Another point of interest is how electronic logbooks could extend the functionality of traditional paper logbooks.

Through conducting a contextual study we investigate how users actually are using the electronic logbooks and whether other media is used for notes which could be of importance and should be entered into the electronic logbook. The usability evaluation made on the electronic logbook used in CCC continues from the contextual study by improving the usability of the currently used interface.

The operators working in the ATLAS control room are using an modified version of ELOG. ELOG is open-source electronic logbook and is freely downloadable [9]. The aim of using ELOG in ATLAS is to get all logbook entries time-stamped and gathered into one single place. Operators of ATLAS will be interviewed in the contextual study.

CCC is the Control Center of the main accelerators in CERN. The operators within CCC are using eLogbook. eLogbook is an electronic logbook developed in-house by CCC operators. Special features of eLogbook are generating automatic input and deriving up/downtime reports from the faults reported in the logbook. A usability evaluation will be conducted on the user interface of the CCC eLogbook.

The Technical Infrastructure (TI) operators are physically situated within CCC. They use their own logbook solutions. The information from their logbooks is also of interest to the operators working on different experiments within CERN. CCC operators, including TI personnel will be interviewed as part of the contextual study.

First a literature review is made in chapter 2. The literature review looks into different electronic logbook solutions used today. Then the research methodology is presented in chapter 3. A contextual study, consisting of a questionnaire, contextual inquiry and testing a free-form logbook implementation, is made as described in chapters 4 and 5. The purpose of the contextual study is to find out in what ways scientists are using their current electronic logbooks. The study also investigates in which ways an electronic logbook could be of better assistance to the scientist. One main point of interest is if an electronic logbook can supply the same level of usability as the old paper logbooks. Then, as described in chapter 6, a usability evaluation is made on the electronic logbook currently used in CCC. Chapter 7 covers the analysis of the gathered data and the results derived from it. Finally, chapter 8 summarizes the whole work and discusses the outcome of this thesis.

2 Literature Review

Within the field of physics research a shift logbook is commonly used and often even required. Many experiments have moved from the traditional paper logbook to using some sort of electronic logbook. Some have used electronic logbooks for as long as 17 years, for example the Alcator (**Al**to **Ca**mpo **Tor**us) experiment at Massachusetts Institute of Technology started using an electronic logbook in 1991 [2]. Many have later developed electronic logbooks for their own use from scratch [6, 10, 11]. Other have taken one of these solutions and adopted them for their own use [12, 13, 14].

Within large physics experiments electronic logbooks become a must. These logbooks are not only needed during operation but also during building and maintenance stages. An electronic logbook is needed in order to maintain a set of logbook entries made by operators who might be located in physically different locations. An electronic logbook also facilitates multiple simultaneous access, easy searchability and accessing attached supporting documentary. [3]

2.1 Development Model

The demand for these electronic logbook solutions is limited to a small market. A consequence of this is that most electronic logbook solutions used today have been developed in-house by physicist with programming skills. Experience at Thomas Jefferson National Accelerator Facility show that the use of operators with programming skills for developing experiment specific software has produced good results. The operators are familiar with the field of use for the developed software. As well it is cost-efficient for the operators to test and prototype software with their colleague operators. [15] This kind of software development process resembles the ad-hoc model. The resulting software quality may vary and is dependent on the individual operators with programming skills. When there is no stable software process in evidence the performance can only be accounted to the individual operator-developer. In this case problems might and probably will appear in the maintenance of this software once the developing operator is no longer working on the project [16]. The operations software group at the Thomas Jefferson National Accelerator Facility have faced similar problems with in-house software development. It is hard to assure that all software has a maintainer who is still employed. Sometimes it becomes hard to find the source code for software where the developer has moved on. [17]

Many of the logbooks developed for use in physics experiments reported need for high usability in the initial specifications [14, 18, 19]. Later reports do not mention any usability work that would have been done. The only way usability is taken into account is through feedback from users once the system has been deployed.

2.2 Innovative Functionality

Many of the electronic logbooks developed for use in physics experiments have designed and implemented new interesting functionality, among others T. Larrieu and T. McGuckin [3]. They introduce a feature for providing guidance to the operators. This feature adds problem-solving guidance which is linked directly to specific components of the accelerator. They also include guidance for making better entries for different cases. The users are then able to use this guidance when making entries. They are also able to improve the guidance. This way operators are encouraged to write better entries with more emphasis on the diagnostic steps.

G. Roediger et. al. present a solution which contains means for free-hand input by using the Cross IPEN [4]. This is an interesting application as the use of free-hand input might lower the threshold of making entries in the logbook. In his master's thesis K. Lundahn studied the use of a digital pen as the entry medium for a electronic logbook [20]. His study describes an implementation of a web-application for use with digital pens. The information from the digital pen is automatically uploaded from the pen to the database behind the web application. The logbook content is then viewable to authorized persons. This solution is mainly targeted at small groups of users and for personal notes.

Automated input is another sales-point for some electronic logbooks. The benefit being that you can have system faults report themselves automatically into the logbook. Another possibility is to let the operator make entries by calling software outside of the logbook which generates specific entries. [12]

3 Research Methodology

This study starts by conducting a questionnaire in order to get some background information about the subject. Then two different approaches to usability design are taken: contextul inquiry and usability evaluation. Both approaches reveal usability problems in the evaluated system. The contextual inquiry gives broader understanding on a higher level, whereas the usability evaluation gives better insight into specific problems in the user interface. By combining these approaches a better understanding of the usability situation of electronic logbooks is achieved.

3.1 Questionnaire

A questionnaire is a well known method for collecting users opinion and demographic data [21]. Two types of questions can be asked in a questionnaire. Open ended questions leaves the answer open to the respondant mainly resulting in qualitative data. Closed ended questions provides the respondant with a predefined set of answers resulting in quantitative data. Specific attentions shuold be paid to designing the questionnaire as ambiguous questions might lead to erroneus results. For this reason the questionnaire should be pilot tested as it is a user interface in its own right [22].

Using a questionnaire in this study is motivated by its cost effectiveness. It is easy to reach a large group of users through a questionnaire. For building a basic understanding of the problem at hand a questionnaire is appropriate. By using open ended questions the questionnaire produces a large amount of qualitative data. Open ended questions also allow the respondants to better explain their answers.

3.2 Contextual Inquiry

Contextual design (CD) deals with the front end of design, from finding out who the customers are to specifying and testing a solution for them. The whole idea of CD is to put the designer in the context of use and participate in the work of the user. CD offers a framework for the whole design process. In this study the CD was used for getting fast feedback. When choosing one CD method for fast feedback on a system contextual inquiry is recommended. [23]

There are four basics concepts to benefit from behind the contextual inquiries. Context is already seen in the name of the framework as the most important concept. By going to the context of where the system is used it is possible to get insight into how the system is used in practice. The second concept is actually observing ongoing work instead of getting a summary of work from the user. People are prone to summarize experience when being interviewed after the actual event. Third when conducting a contextual inquiry one gets concrete data instead of abstract. People likes abstracting because it is much easier than giving a detailed report. This hides the specific details that the designer is looking for. The fourth concept is partnership. By sitting down together with the user and "working" with him the interviewer is on the same level with the user. In the traditional interview setup the interviewer gets a too controlling position. [24]

3.3 Heuristic Evaluation

Heuristic evaluation is a fast and straightforward method for finding usability issues in an user interface. The evaluation is normally done by a group of usability experts looking through and using the interface in question. The results of a heuristic evaluation gives good clues to where in the interface users might run into problems. By later concentrating on these problems in the user tests the real issues can be identified. Heuristic evaluation combined with user test gives a efficient tool for evaluating usability.

Heuristic evaluation as described by Nielsen and Molich is a systematic approach to inspect the user interface. They describe a set of ten heuristics to be followed when inspecting the user interface. These heuristics are: simple and natural dialogue, speak the users language, minimize the memory load, consistency, feedback, clearly marked exits, shortcuts, good error messages, prevent errors and help and documentation. [25]

Simple and Natural Dialogue

Dialogues should not contain irrelevant information. All information should appear in a natural and logical order. Error codes is one example of irrelevant information.

Speak the Users Language

The interface should use language understandable to the user. System oriented terms should be avoided. Terms specific to the users cultural environment should be used.

Minimize the Memory Load

The user should not have to remember information from one part of the dialogue to another. Instructions for the system should be easily retrievable at all times.

Consistency

Wording should be consistent. The user should not need to wonder wether different words are used for the same thing. Consistency also means applying common standards.

Feedback

The system should always tell the user what is happening and keep the user informed of the systems state.

Clearly Marked Exits

The user should always be provided with a clearly marked option to cancel his actions. Users often choose functions by mistake and will need to leave the unwanted state without too much work.

Shortcuts

Shortcuts provide better usability and faster interaction for experienced users. These shortcuts are normally unseen for the novice user, but are learned as the user becomes more familiar with the system.

Good Error Messages

Error messages should blame the problem on the system and not on the user. The error message should contain good constructive suggestions as how the user could elude the problem in the future.

Prevent Errors

Preventing errors is even better than good error messages. Many errors can be prevented in the first place by good design.

Help and Documentation

Help and documentation should be provided to the user. Even though documentation is seldom referenced by the user, good documentation can help the user when he has found himself in a deadlock. Good documentation consists of instructions how to perform usual tasks rather than just explaining the functions of the system.

3.4 Usability Testing

Usability testing is conducted with real users of the system. Testing with real users is the most fundamental usability method, as working with real users of the system shows how they actually interact with the product. Usability testing was introduced by J. Nielsen [22].

User tests consists of a predefined set of tasks. The tasks are given to the test user by the experimenter one at a time. When carrying out the tasks the test user is asked to think out loud, which means speaking out what and why the user is doing in order to perform the given task. When the user is finished with one task he is presented with the next one.

User test sessions are documented by notes taken by the experimenter and often by means of digital video-cameras and screen-capture hardware. The most important documentation is the notes taken by the experimenter as they already contain some analysis. The accountability of the notes can be verified by going back to viewing recorded tapes of the test session. [22]

3.4.1 Thinking Aloud

Thinking aloud means that a person speaks out the reasons for his actions when conducting a certain task. Thinking aloud also includes speculating about an action before taking it. Basically thinking aloud means speaking out the whole progress of thought from getting a task until reaching the objective or failing. Thinking aloud is a method often used in user tests. The objective of making the test subject think aloud is to be able to follow his train of thought throughout the test-session and thereby understand the users actions.

An alternative to thinking aloud is using a pair of user in the user tests. When two users try to solve tasks together this results in a discussion between the users. From this discussion the experimenter is able to understand the thoughts of the test users. Using pairs in user tests is useful if the application is normally used by more than one user. Here we will use the thinking aloud method as the application is normally used by a single user.

Thinking aloud is a basic method regularly used in user tests to enable the experimenter to understand the users actions. [26]

3.4.2 Evaluating the Improvements

The proposed improvements needs to be evaluated before giving them to the software developers. If the improvements are not evaluated the resulting interface might actually become harder to use. Therefore it is of essential importance to evaluate the improvements before implementing them into the system. Evaluating the improvements can be done by making fast paper prototypes and testing them with a few users. Testing structural modifications can be verified with orderirng tasks where users are asked to order the different items the way they find logical. [22]

4 Questionnaire on the Use of Shift Logbooks

A questionnaire was made in order to get familiarized with the use of logbooks and to get background material. Open ended questions were used in order to get more detailed answers from the users as qualitative data is preferred over quantitative data in this study. The questions of the questionnaire are shown in Appendix 1. The questionnaire was distributed to people who are working on experiments in either CCC or ATLAS. The questionnaire produced a total of 30 responses. The results of this questionnaire works as a base for the contextual study and user tests performed. The focus of the questionnaire was to gather info on the main use cases of the electronic logbook and to clarify if paper logbooks still are widely used.

The most common types of entries into the electronic logbook are starting and stopping of equipment or systems, encountered problems and solutions to them, critical changes made and instructions for people on the following shift. Entries which do not reach electronic logbooks are calculations, formulae and graphs done by hand in paper logbooks. Some of the respondents also use paper logbooks for personal notes concerning the experiment. These notes could well be of assistance to other people participating in the experiment.

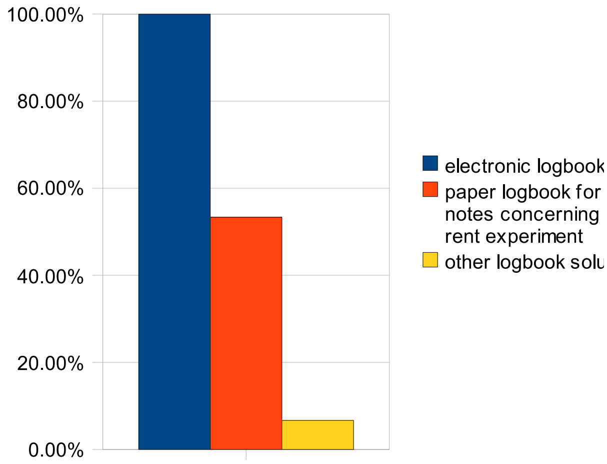

Figure 4.1: Proportion of users using different logbooks

All of the respondents were naturally using an electronic logbook, but there was a significant amount of scientists who still partly rely upon old fashioned paper logbooks as seen in Figure 4.1. This foretells that there might be some problems with the usability of the electronic logbook. We must consider that the results of a questionnaire might be inaccurate while answers might be biased by people answering what they think is the correct answer instead of according to their own experience [22, p. 214]. Another thing to take into consideration is that scientists who have been encouraged to use electronic logbooks by the experiment managers, may be answering that they solely use the electronic logbooks even though they enter some information into personal paper logbooks.

Respondents who were using paper logbooks reported reasons for use such as, drawing sketches and calculations, storing contact information such as names and phone numbers and specific information for personal reference. These are issues which will be taken into account in the proposal for improvement.

5 Contextual Inquiry of Operator Logbooks

Contextual inquires were conducted with operators of CCC and ATLAS. The main focus of the interviews was in what artifacts where used alongside the logbooks and for the paper logbook users which entries into the paper logbooks are currently impossible with the electronic logbook. During ATLAS test runs in October 2007 a digital pen logbook was tested.

5.1 CERN Control Center

CCC is one big room organized into four so called islands. Different accelerators are monitored from different islands. Many different groups work in the same place collaborating in order to get the accelerator to work together in an effective an well structured manner. Most users in CCC use the CCC eLogbook as a common medium. The sole exception is the technical infrastructure (TI) group, they have three different logbook solutions.

Three operators working in CCC where interviewed, two PS operators and one member of TI. The tasks of these users differ a bit and therefore the results are divided into different sections.

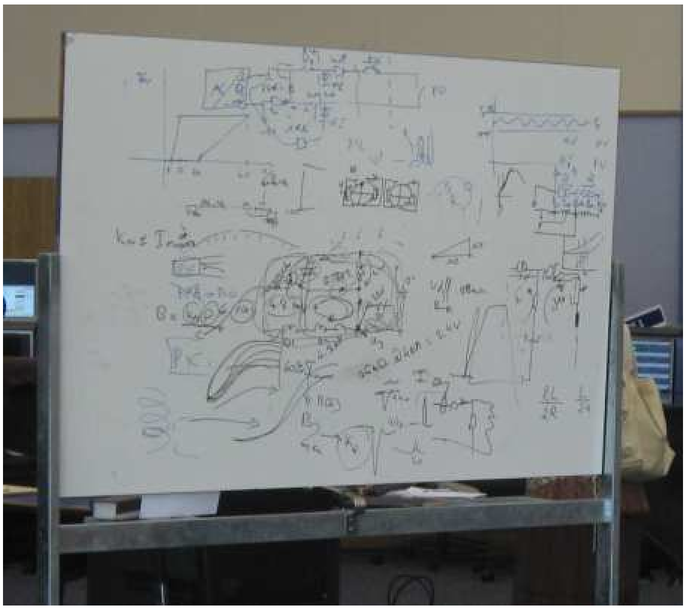

Figure 5.1: Whiteboard in CCC

5.1.1 PS Operators

The PS operators work from their own island within CCC. The operators who where inquired both used personal paper logbooks or notebooks. The personal notes taken during the interviews were mainly small reminders about what was done. When a larger task was completed an entry was made in the eLogbook.

So the eLogbook was used by the operators to some extent but some problems appeared. Problems in the interface hindered the users for making wanted entries. These same problems were also later identified in the usability evaluation (chapter 6).

Apart from the eLogbook and paper logbooks the operators used a whiteboard located in the center of CCC (Figure 5.1. The whiteboard was used for illustrating thoughts to colleagues. The whiteboard was also used when discussing topics and solving problems in groups.

5.1.2 Technical Infrastructure

Technical Infrastructure monitors and takes care of the entire technical infrastructure of CERN. The TI operators are physically placed in CCC for reasons of convenience. TI mainly uses three different logbooks. They all cover work and events which are connected to TI's responsibilities.

One is an electronic logbook into which the operator can make entries about either major or minor events. One is an automatically generated record of issued work orders. This contains all future scheduled maintenance work and currently ordered work. One is an Microsoft Notes table which is shared between the TI operators. This table contains ongoing work. When a contractor starts work on some equipment he calls into TI to inform what he is doing and the operator records the contractors start of work and telephone number into the table. Ideally the contractor should call in and inform the operator when work is finished. This however does not always happen. Currently these three logbooks have separate interfaces. Combining these different solutions would make work easier for the TI staff. At the same time combining the information from these different logbook solutions would make it possible to get a faster overview of what is going on.

The current solution works for the TI staff, but problems occur when other groups who are affected by work done by TI need to stay up to date. With the current solution it is too complicated for other to access the logbook data of TI.

5.2 ATLAS

ATLAS (A Toroidal LHC ApparatuS) is one of the six particle detector experiments constructed at the Large Hadron Collider (LHC). The operators monitoring the ATLAS experiment work in a control room similar to CCC but smaller. The operators use an electronic logbook called ATLOG. ATLOG was studied as part of the contextual study. During test runs in October 2007 a digital pen logbook was tested in ATLAS to gain understanding on how free-form entries in electronic logbooks could be handled.

5.2.1 ATLOG

The operators in the ATLAS control room use ATLOG, an adopted version of ELOG. The use of ATLOG has been motivated by the thought that forced strictly formatted input helps keep the logbook well structured and easy to search. The objective in ATLAS has been to keep all logbook data in one place, in the ATLOG, and refrain from using paper logbooks. While the goal is to keep ATLAS paper-free the real situation is quite different as can be seen in Figure 5.2. During my inquiries I found that the operators are still using paper logbooks for making so called personal notes. These personal notes are fine grained notes about the process of solving problems. The input into ATLOG is a much coarser version of the solution.

One reason for scarce input into ATLOG during my inquiries revealed to be that the operator working on the test run was unsure of what information to enter into ATLOG and mainly kept notes in his own personal paper logbook. Another problem for the operator was with the strict requirements on the entries. In order to just make a small simple entry a multitude of meta-data has to be entered as well.

Figure 5.2: The desk of one operator in the ATLAS muon test run

5.2.2 ATLAS Digital Pen Case

The digital pen logbook implemented by Kalle Lundahn [20] was tested in ATLAS control room during test runs October 2007. A laptop with connected digital pen and appropriate logbook was setup. The managers and a few operators were instructed on the use of the logbook.

During the test run a few entries were made in the logbook. However they were not transferred to ATLOG. After just one or two shifts the laptop was pushed aside and forgotten by the operators. The tests were repeated three times. The same results persisted.

The operators where interviewed about the use of the digital pen logbook. The reason for minimal use of the logbook was the threshold for using it. The user was forced to first use the pen to make the wanted drawing or formula. The pen should then have been docked into the docking station connected to the laptop. Then the image needed to be moved from the digital pen logbook to the ATLOG.

This was too much for the operators to cope with for small entries. Therefore the ease of making hand drawn pictures with the pen was diminished by the cumbersomeness of getting the information from the pen into ATLOG.

In order to benefit from the digital pen interface the insertion of digital pen entries into ATLOG should be automated. One solution would be to have the data from the pen automatically uploaded to ATLOG when the digital pen is docked. This however stands in contradiction with the requirements on metadata to be entered with each entry.

5.3 Work Models

Work models are made in order to illustrate and give good view of how work is done and where the problems arise. The most common work models made when striving for fast feedback are the sequence model and the artifact model [24].

5.3.1 Sequence Model

A sequence model was made in order to illustrate a typical interaction with the eLogbook (Figure 5.3). The sequence is initiated by the trigger; somebody reports a problem to the operator. The arrows indicate the sequence of steps taken in order to satisfy the intent and the red lightning bolts indicates a breakdown in the sequence. In this case the breakdowns occur when the operator fail to report on progress into the eLogbook while solving the problem. Another breakdown occurs when the operator has to return to the analytic software to get screen-shots illustrating the problem and solution. When the entry is made it might already be too late to get the screen-shot. This is partially related to the first breakdown. If events where entered during the solution process this second breakdown would be

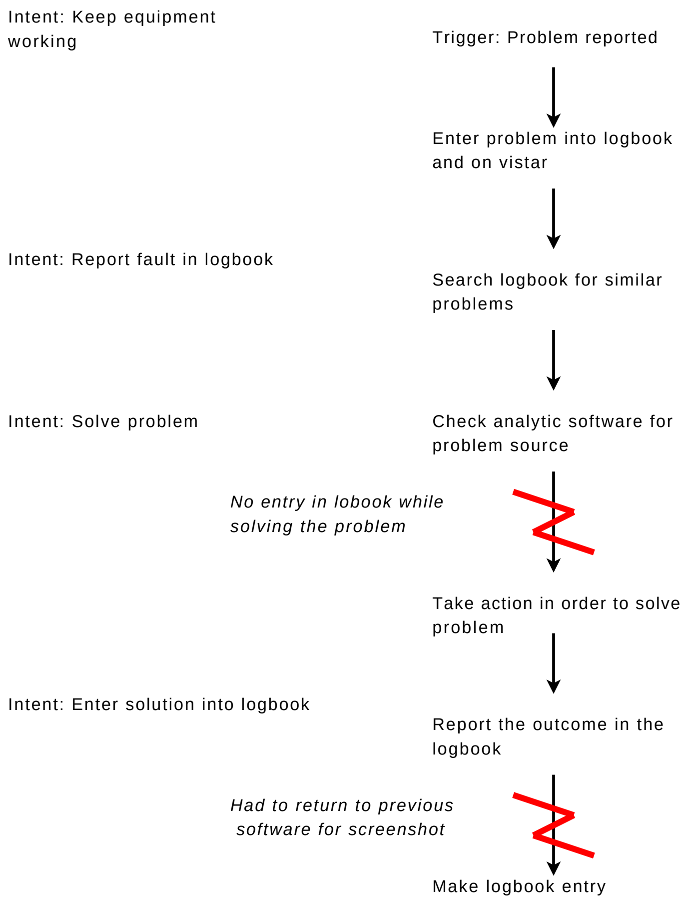

Figure 5.3: Sequence model of typical eLogbook use case

avoided. The consequence of these breakdowns is coarser entries in the logbook. This makes it harder to recapture the steps taken to solve the problem.

5.3.2 Artifact Model

By studying artifacts it is possible to reveal useful information of how the user interacts. Main artifacts present in CCC where the electronic logbook, paper logbooks, vistar and a common whiteboard.

Electronic Logbook

Examining the eLogbook shows how the information in the electronic logbook is different from the paper logbook. In the electronic logbook you can find entries such as “fixed” as the single entry of a solution to a problem. Comparing this with paper logbooks shows that there is a drastic loss of information when switching from paper to electronic. Automatically entered data can be seen in the eLogbook. There is also some entries that could be automated, for example many operators make an entry when their shift starts reporting that they are on duty. It would be easy to automate this function, making an automatic input wherever an operators shift starts. This entry could also contain contact information so the operator in question could be contacted easily if need be. Differences to the paper logbook can be found in the lack off annotations. There is no possibility to comment on old entries, correcting them or adding information.

Paper Logbook

Investigating the paper logbooks used by the operators many features are straightforward. For example the notes are arranged by date and time and organized into entities containing one shift. There are however breaks in the practice of making the entries in timely order. Sometimes old entries are annotated and side-notes are added to old pages.

In the paper logbooks formulae and hand drawn graphs are often nested in the notes. Sometimes printed graphs are pasted into the paper logbooks.

Vistar

The vistar is a big screen situated on the wall of the control center. The vistar displays information about the accelerators or experiments current status. An info-message on the vistar can be updated through the eLogbook. The info-message was used for telling operators about upcoming breaks in the runs and other current information.

Whiteboard

There is a whiteboard located in the center of CCC. It is used, when needed, by any of the different groups working in CCC. During the contextual inquiries it was mainly used for solving problems in groups. Having a common drawing board for interactive group discussion is needed to solve problems. The structure of data on the whiteboard while solving problems resemble a mind map with lines connecting different thoughts and topics.

6 Usability Evaluation of the CCC eLogbook

An usability evaluation was performed to improve the usability of the next generation of the CCC eLogbook java-client. The usability evaluation consisted of a heuristic evaluation and user tests. On the basis of the results from the usability methods a proposal for improvement was created.

The CCC eLogbook is an electronic logbook application. The application allows you to read and write logbook entries. The application also allows you to leave instructions for later shifts. Special features of the logbook are, linking faults to entries, updating a message shown on the vistar corresponding to the machine of the logbook, inserting automated entries (shift intensities), and using a built in screen capture function.

6.1 The eLogbook

The eLogbook interface consists of two different parts, a java-client used for editing the eLogbook used in CCC and a web-interface for viewing and searching the eLogbook. The web-interface is also used for remote editing of the eLogbook content.

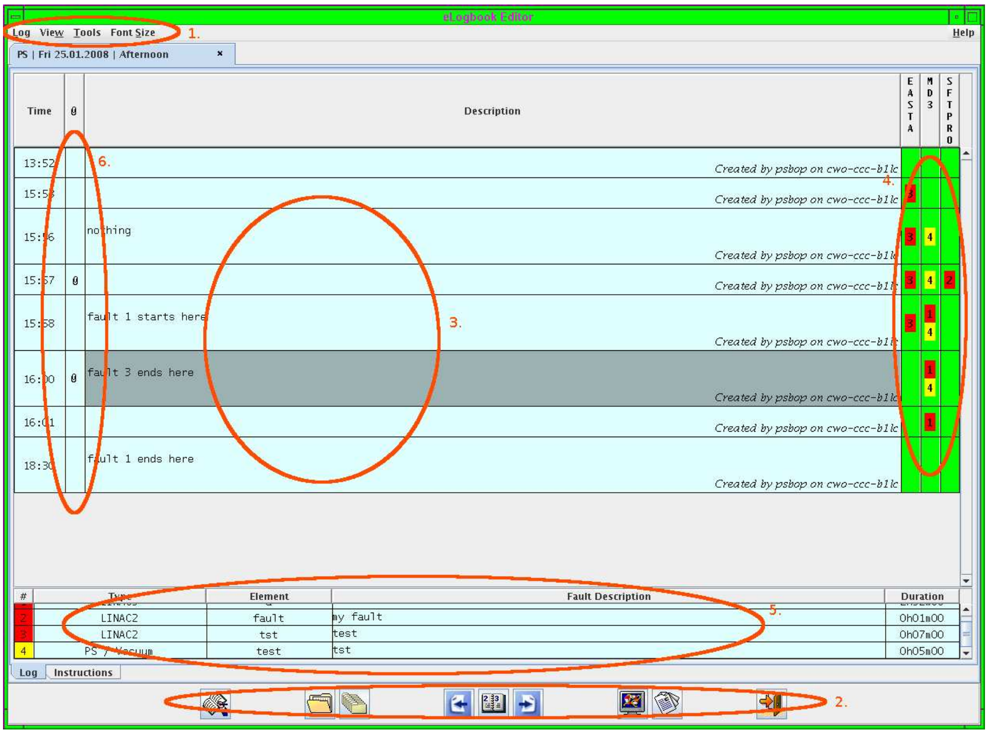

Figure 6.1: Basic view of eLogbook editor interface:1. Top menu 2. Bottom row buttons 3. Entry fields 4. Fault visualisation 5. Fault descriptions 6. Attachment sign

6.1.1 The eLogbook java-client

The java-client is a standalone java application which connects to the backend database. The java-client is used by operators in CCC. It is designed for editing the logbooks, mainly by making new entries and reporting faults. A basic view of the eLogbook java-interface is shown in Figure 6.1. Through the top menus you are able to open a specific logbook shift, add event, go to next or previous shift, print, close the editor, open the web-interface, edit the vistar message, insert automated entries and change the font size (Figure 6.1, part 1). Shortcuts to some functionality are utilised through the buttons in the bottom row (Figure 6.1, part 2). These are new entry, open last shift, open specific logbook shift, previous shift, go to date, next shift, edit vistar message, open in web and quit application.

Some functionality is only reached through right-clicking on the entry-fields in the interface(Figure 6.1, part 3). Such functionality include: adding a fault, adding a line, setting operations mode, adding an instruction, and adding a new entry with fault. On the right hand of the interface open faults related to a specific line or machine are visualised (Figure 6.1, part 4). The description of the fault can be found in the lower part of the interface (Figure 6.1, part 5). If an attachment is added to a certain entry it is shown by a symbol in the left-hand column (Figure 6.1, part 6).

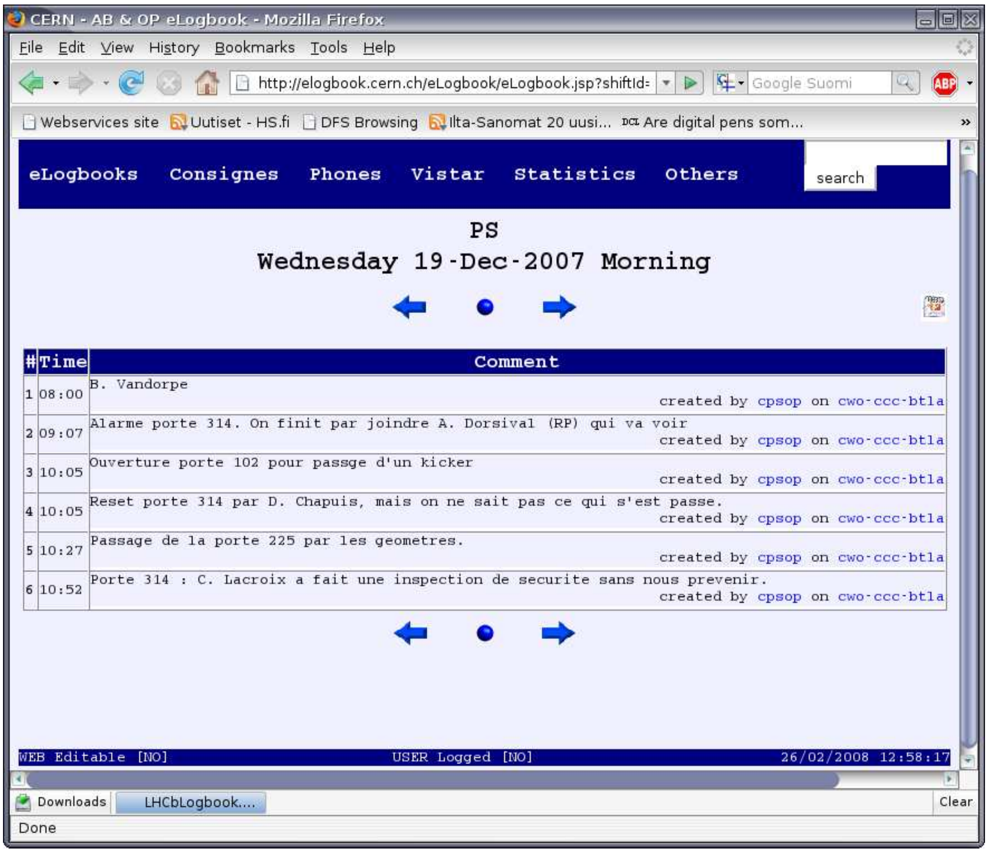

Figure 6.2: Basic view of eLogbook web-interface

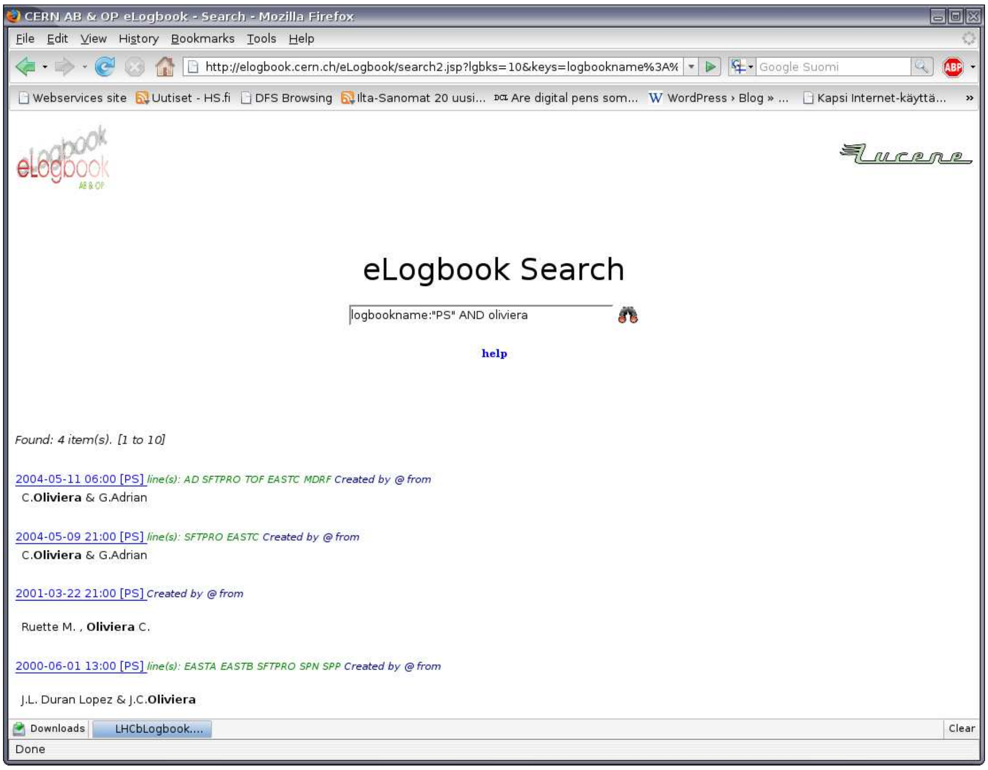

Figure 6.3: Basic view of the search-page

6.1.2 The eLogbook web-interface

The web-interface can be reached through http://elogbook.cern.ch from within CERN. The web interface is used for browsing and searching the logbooks. It is also possible to edit the logbooks through the web-interface, this feature is used by users outside of CCC. A basic view of the web-interface is shown in Figure 6.2.

Searching the eLogbook is only possible through the web-interface. Accessing the search engine is done through the search field in the top right corner of the interface. The search opens a new window as shown in Figure 6.3

6.2 Heuristic Evaluation

A heuristic evaluation was made of the CCC eLogbook java-client user interface. Normally heuristic evaluations are made by a group of usability experts. In this study the heuristic evaluation was done solely by the author. To try and cope with having only one person doing the evaluation it was made in two sessions. The sessions were separated by one week. The results were then consolidated. During the first session 52 distinct problems were found. After consolidating the results of the second session a total of 68 distinct problems were indentified. This shows a 30% increase of problems found.

6.2.1 Results of the Heuristic Evaluation

The result of the heuristic evaluation is a list of problems as shown in Appendix 2. The problems were split up into problems in the web-interface and problems in the java-interface and were then arranged into comprehensible groups using an affinity diagram. Using an affinity digram is a method for consolidating a large amount of data [24, p. 154-163].

Problems in the java-interface

The problems found in the java interface were grouped as follows: Dialogs, Interaction Area, Menu and Functions (Figure 6.4).

The most critical group of problems is the Menu group. The menus are not following the norms. The titles of the menus are: Log, View, Tools, Font Size and Help. These should be replaced by “de facto” standard titles used in other applications. Another problem which is related to the menus is that only a small

Figure 6.4: Affinity diagram of the problems found in the java-interface

part of the functionality is reachable through the menus. Every function should be found through the menus, otherwise the user will not know what functionality is present in the application. Using shortcuts, such as right-click menus, is good practice but to search the whole user interface before you know where something is hidden creates a bad situation for the user.

The second most critical group is the dialogs. The problem with the dialogs is that a few of them are missing so called exits. There should always be a cancel button so the user can stop what he is doing without anything irreversible happening. Furthermore some dialogs use widgets which are not standard, these should be replaced by radio buttons, drop-down menus etc.

The problems with missing functionality is less critical then the ones above. It contains such problems as there is no way of changing the end of a certain fault if it is accidentally ended too early. The way to remove a line is a bit misleading, you set the operation mode to not selected in order to remove a line. Also there is no way of removing a fault.

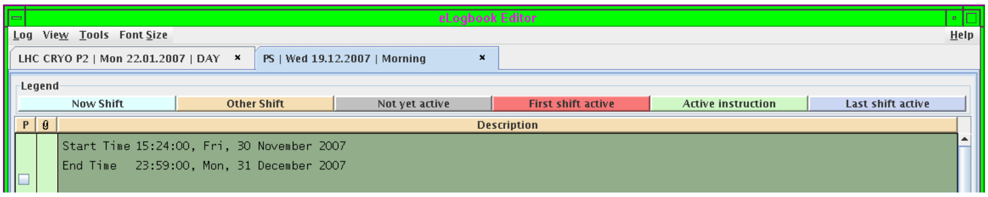

Figure 6.5: The colour legend is shown in the top part of the interface when viewing instructions

The last group of problems with the java-interface is concerned with the actual area where the logbook entries are shown. The area contains much functionality which is available through right-clicks. However you must first select a certain cell by left-clicking it in order to interact with it by the right-click, this might confuse the user. When viewing the instructions a legend of the colours used is shown in the top row as shown in Figure 6.5. The coloured fields look like buttons and users will be compelled to push these in order to see certain instructions, i.e. “active instructions”. The language used in an interface should be coherent, use of terms such as “consigne”, which is French should be avoided. Use of one language throughout the interface is advised.

Problems in the web-interface

The problems found in the web-interface were arranged into the following groups: structure, consistency and layout. The affinity diagram can be seen in Figure 6.7.

The most critical issue with the web-interface is concerning the layout and how the interactive elements are shown. If the user is logged in and browsing an web-editable logbook it is possible to make new entries. The functionality can

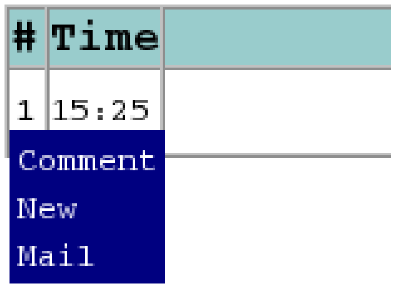

Figure 6.6: Drop-down menu in the web-interface

be found through a drop-down menu from the previous entry number as shown in Figure 6.6. There is no hint of how to add a new entry, the user just has to know where to move the mouse. Both the “new shift” and calendar buttons are small and unnoticeable.

Consistency or rather the lack of consistency is the second group of problems in the web-interface. The layout and functionality should be as close as possible to that of the java-interface. The layout of the search-page now looks like a different site all together. Users might get confused when there is no single approach to the layout.

The last group of problems with the web-interface concerns the structure of the service. The functionality and content of the site should be organized in a way that represents the users image of the system. Now the structure is misleading as the links in the top menus are not grouped in a logical fashion. Links which are connected to a certain logbook are found in different places in the menus. This makes it hard for the user to understand which content is connected to the active logbook and which content is general.

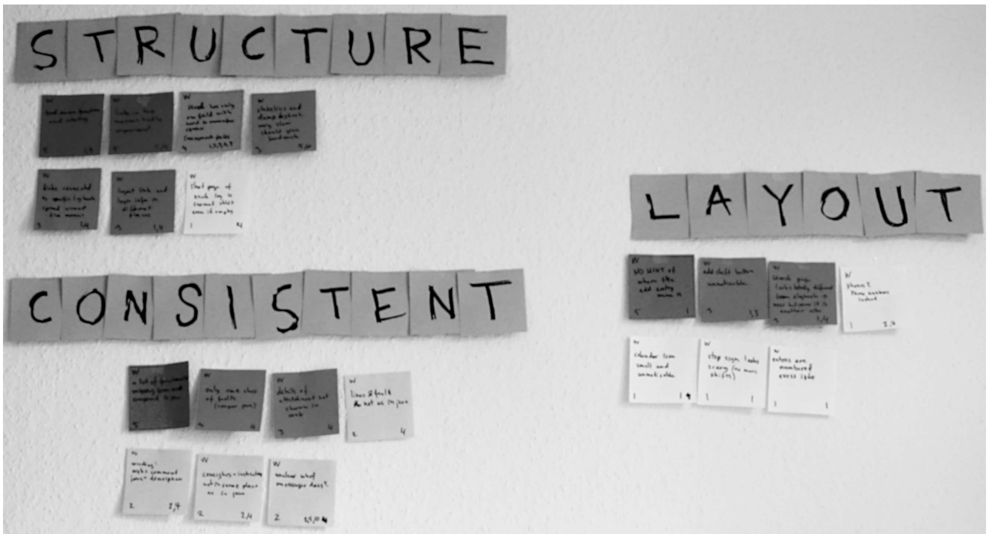

Figure 6.7: Affinity diagram of the problems found in the web-interface

6.3 Usability Tests

Usability tests were performed on the eLogbook user interface. The tests were planned and took place during March 2008. The tests resulted in the proposal for improvement presented in chapter 7.

6.3.1 Test Plan

The goal of the tests was to find actual problems the users have with the user interface. The tests concentrated on efficiency and ease of use over learnability as the interface in question is used by experts on a regular basis. Some attention was however given to learnability as well as some users may only be using the interface for a few weeks per year. The most critical functionality in the user interface was tested. The success and failure to fulfill the tasks was recorded. The goal for the success-rate of all tasks was 100%. This demand for absolute success-rate was due to the nature of the tasks. All tasks were fundamental and should be accomplished without failure.

The tests took place in CCC. This is the environment where the users normally work. It would as well have created a lot of overhead to setup a test environment elsewhere.

The tests were planned to take about one hour per user. The computers in CCC were used for the tests. The software needed for the tests was installed on the computers in CCC. When the users started with their test tasks the computer were turned on but no applications were started. The users supposedly how to start the application as they have been working with the previous version. The author of this thesis served as experimenter for these tests. The test users were recruited from the group of people who in reality uses the application in question. Four test users were recruited including one user for the pilot test. The user test tasks can be found in Appendix 3. The users were asked to think aloud while working with the application. If a user got stuck with a certain task the experimenter helped him through it to avoid frustration. If the user ended up in a dead-lock the experimenter explained the situation and gave the test user the next task. Data was collected with the help of a digital video-camera and the experimenter taking notes. The video tape and gathered notes were reviewed by the experimenter after each test session.

6.3.2 Pilot Test

Before the actual tests a pilot test was performed. The pilot test brought forth some problems with the test tasks to be performed. Based on the pilot test changes were made to the actual user test tasks. The changes included rearranging the order of the first tasks and making the tasks more detailed.

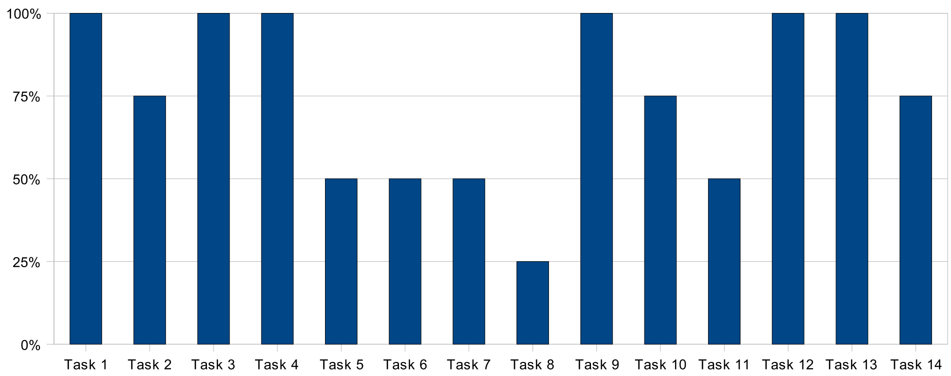

Figure 6.8: Rate of successfully finished tasks

6.3.3 Results of the Usability Tests

Most of the problems found in the heuristic evaluation were affecting the performance of the users in the user tests. The problems found through the user tests were again grouped with the help of an affinity diagram. The resulting groups were: managing faults, name and place of functions, search related problems, dialogs and problems concerning the state of the application.

Managing Faults

This is the most critical group of problems found in the user tests. Managing faults is one key functionality in the application and should therefore be considered and redesigned carefully. As seen in Figure 6.8 the tasks 6, 10, and 11 which are related to managing faults have a success rate of 50-75%. This shows that improving this functionality is critical. The problems with adding, starting and ending faults correctly seems to derive from the variety of functions being linked with this activity. When adding a new fault the user has problems with choosing between: add event, add event with fault, add fault, and start fault. The same problem arises when ending a fault. The user has to choose between add event, and end fault. In the current interface choosing end fault without first adding an event will result in an erroneous entry. Another problem users were experiencing was with where to click in order to add the desired entry. Depending on which column of a previous entry is selected a different set of functionality is available. Some users tried to find the functionality through the top-row menus but only a fraction of the functionality can be found there.

Functions

The problem with the functions as discussed in section 6.2.1 is that most functionality is hidden from the user. Browsing the top menus only reveal a fraction of the functionality. Discovering where and what else is possible through the interface can take a long time for the user. The demand for the user to first left click to select a specific cell, then right click in order to open a menu with functions furthermore obscure what can be done in the interface. Users simply tried to right click on cells expecting interaction. This caused confusion among the users as the functionality seemed unpredictable.

When users sought to enter shift intensities into the logbook, a function which is found inside the application launcher, they ran into problems. Only through trial could they figure out that what they were looking for was found inside the application launcher. When updating the message on the vistar none of the users used the Main Page Message function from the menu, even though some browsed the menus first. Eventually all users ended up using the button in the bottom of the interface. This reflects that the icon for the button is appropriate, but the function name in the menu does not correspond to the sought for functionality. The poor result with these functions relates to the results of tasks 5 and 9 as seen in Figure 6.8.

Searching

The currently available search functionality is not directly reachable from the java interface. The users had problems trying to find the search functionality and tried to browse through the menus in order to find it without success. When found the users had a hard time using it, since there are no special fields for search by for example date, logbook, author etc. The users also would have expected search functionality within the java client and did not like the need for opening a web browser in order to perform a search. The success rate of the search task is only 25% as seen in Figure 6.8, task 8. This is due to the fact that the search utility was not found and that the search utility stalled.

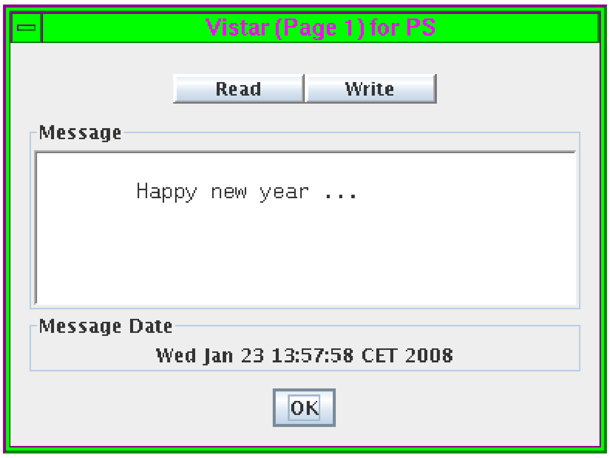

Figure 6.9: Original “Main Page Message” dialog

Dialogs

When interacting with the interface the user experienced problems with various dialogs. The problems included not realising some of the demanded selections. Mainly not recognizing the drop-down menus in the dialogs and bypassing them, resulting in an error message prompting the user to choose a value, even though there in some cases only existed one single option. Some users had trouble with changing the vistar message with the dialog. This was due to insufficient feedback and ambiguous control buttons, see Figure 6.9. Selecting the desired time-frame for new instructions turned out to be difficult due to the date and time entry fields. Changing the time and date demanded a strict format for the input.

Application State

The state of the application is not always clear to the user. Some of the users did not realize they were viewing instructions and not log events. Having all buttons and menu items functional all the time even though they are not applicable confuses the user.

6.4 Evaluation of the Proposals for Improvement

The proposals for improvement where evaluated with one user. The evaluation was done with the help of a paper prototype. The prototype consisted of printouts of the new interface and post-it notes with menus of functions. When the user “clicked” on the interface the appropriate menu was shown to the user. The basic parts of the paper prototype are shown in Figure 6.10. The structure was tested against the users ideas by letting him group the functionality under the different menu-headers. The wording of the functions was also evaluated by letting the user explain what he thought would happen by using the function. Some inconsistencies where found in the prototype and the proposals for improvement where updated accordingly. On average the improvements got a warm reception.

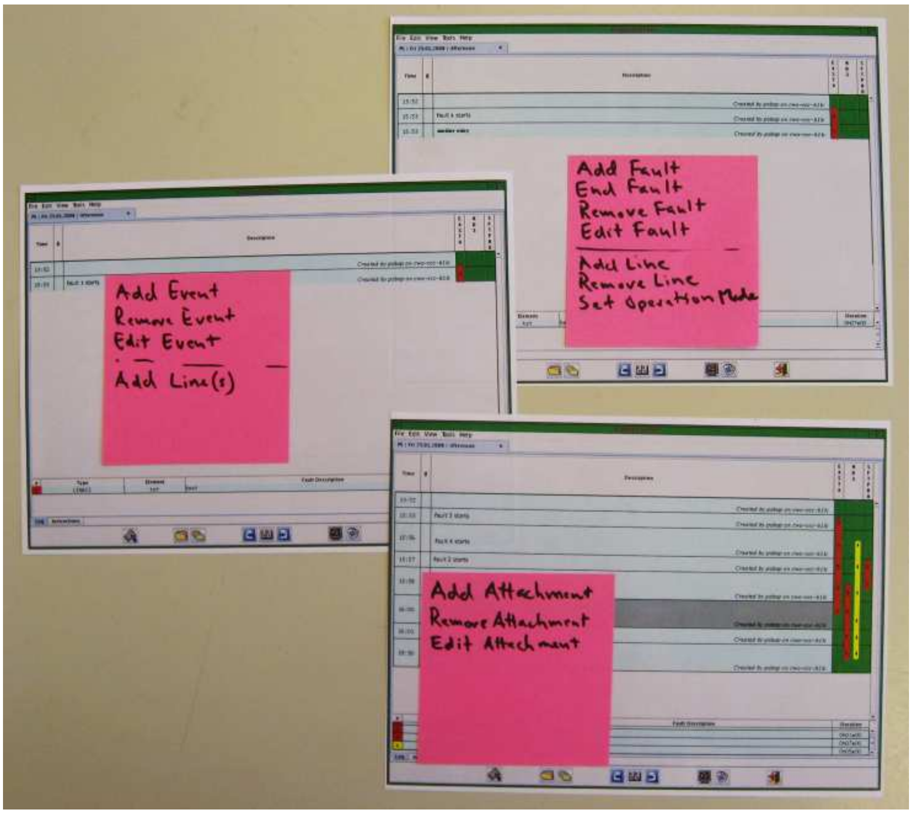

Figure 6.10: Paper prototype of improved interface

7 Results

7.1 Proposal for Improvement of the User Interface of the CCC Electronic Logbook

The problems found in the heuristic evaluation (chapter 6.2) and the user tests (chapter 6.3) were used as a basis for the proposed improvements to the user interface. The improvements were evaluated with one user and the results of these evaluations where incorporated into the proposals as described in 6.4.

7.1.1 Main View and Interaction

The users experienced problems when interacting with the cells in the main view. The problems were mainly due to the fact that the user must first left click a certain cell in order to activate it before applying a function to it by right clicking. By allowing the user to select a cell and interact with it directly by one right click would bypass this problem.

The interaction buttons in the bottom row are nice shortcuts for often used functions. However the buttons are not always applicable. The buttons should be disabled when not of use to the user. When viewing the instructions the "add entry" button is still available, in this circumstance the user might try to add a new instruction by pressing this button. This however leads to an erroneous result, a new logbook entry is made, but the user gets no feedback as he still only sees the instructions and no new entry.

In the main view of logbook entries attachments are identified by a small paper-clip image in the attachment column. For the users convenience a thumbnail in the entry field would give faster visual feedback to the user about the content of the attachment.

7.1.2 Dialogs

Many of the dialogs of the user interface contained features which produced problems for the users. The improvements are presented for each dialog.

Main Page Message

The name of the function and dialog should be changed to “Vistar Message” to better match the users language. The buttons “Read” and “Write” should be removed. The “OK” button should be replaced by “Reload”, “Save” and “Cancel”. To cope with simultaneous users the message dialog should be frozen if someone else is already modifying the message. A short explanation should be given in the dialog in case the message is being edited by someone else. A suggestion of the new dialog can be seen in Figure 7.1

View Attachment

It is impossible to view attachments with the current interface. There is only a thumbnail viewable in the “Edit Attachment” dialog. If the user wants to see

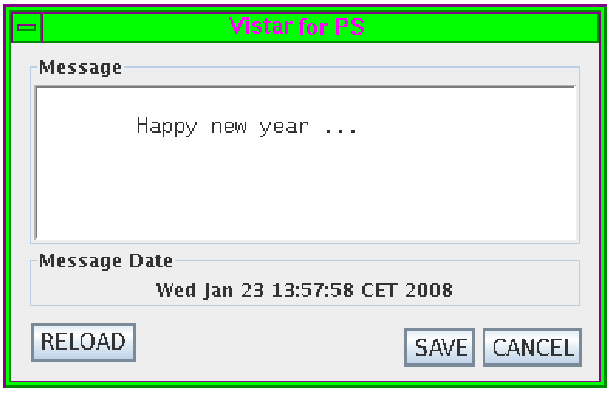

Figure 7.1: New “Vistar Message” dialog

the entire attachment he must first open the web-interface of the logbook. There should be functionality for viewing the attachments in the java-client as well.

Edit Attachment

In the edit attachment dialog shown in Figure 7.2 the user is allowed to remove attached files. However when removing a certain attached file there is no confirmation dialog and the attachment is lost without possibility to cancel the removal. At least a confirmation dialog should be implemented. Having a cancel button which would discard all changes made with the dialog would be advisable. This dialog could contain the possibility to view the complete attached files as well as the thumbnails.

Add Instruction

The dialogue for adding instructions uses fields for changing the date which caused problems for the user. Instead of the current text-field for date entry a calendar could be used. The time could be entered in its own field.

Figure 7.2: Attachment manager dialog

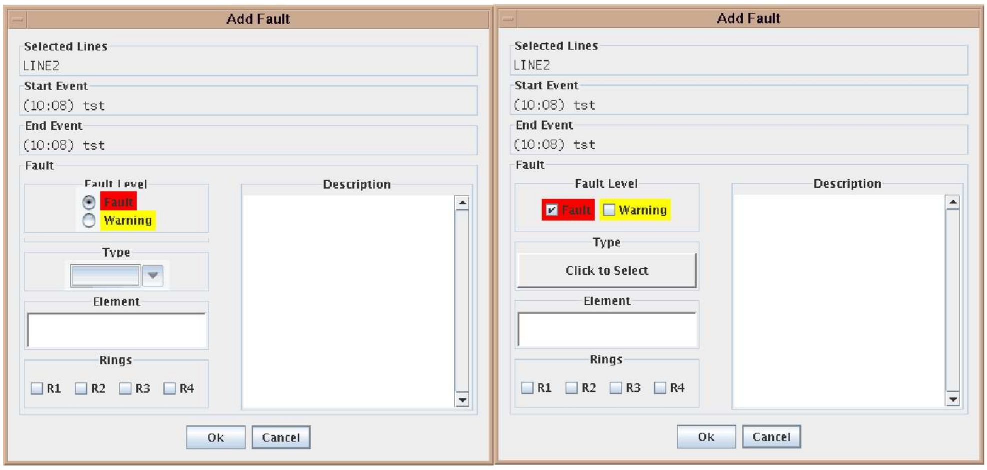

Figure 7.3: Improved and old add fault dialog

Add Fault

In the add fault dialog the user has to choose between two fault levels. In this case the appropriate widget is radio buttons. The type drop-down menu is now visualized as a button. This should be changed to a drop-down menu. The improved add fault dialog is shown in Figure 7.3 on the left and the old version on the right.

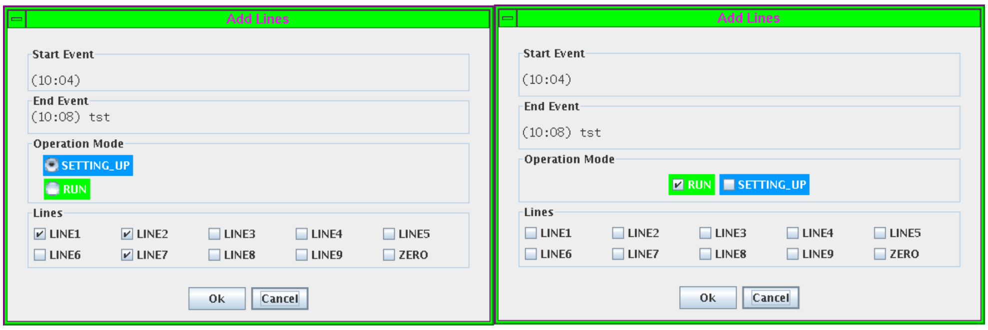

Figure 7.4: Improved and old add lines dialog

Add Lines

The widget used for selecting operation mode should be replaced by radio buttons. Radio buttons are preferred when selecting one option form a few. The check-boxes used for selecting active lines behave in a strange fashion. When a new line is added the check-box option is removed from the list. A better option would be to leave all options visible and make the active lines prechecked. An illustration of the improvements and the old version is shown in Figure 7.4.

Set Operation Mode

The "Set Operations Mode" dialog uses a non-standard widget for choosing the mode. Since the user has three different modes to choose between the preferred widget would be radio buttons. This way the user will see the three options straight away. The most frequent value should be set by default, i.e. RUN.

7.1.3 Legends

Currently legends are shown both in the instructions view and in the dialog for adding lines. The legend for shifts and instructions are shown in the instructions

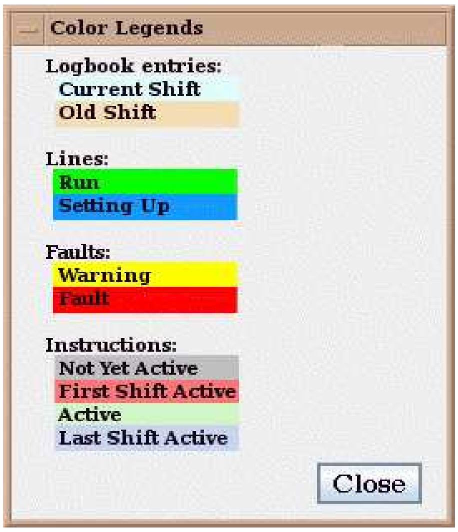

Figure 7.5: Proposed colour legend dialog

view. This legend looks like buttons. The legends could be gathered into one place with proper explanations and displayed in a dialog found under the Help menu. An example colour legend dialog is shown in Figure 7.5. The dialog could contain more detailed explanations about the different cases. After these colour legend have been in use for a while it would be a goo idea to follow up with users and check if they know what the colours mean. For example the instructions are colour coded with four different colours. This might be excessive and might be better if replaced by only “active instruction” and “non-active instruction”.

7.1.4 Handling Faults

In the current version of the application the user has to choose from a multitude of functions when starting and ending faults. This makes it hard for the user to know what to use. Removing some of the functions will simplify the interaction.

In the proposed improved version the user would be provided with functionality by right-clicking a specific line of an event. The following functions would be offered: add fault, end fault, remove fault, and edit fault. Depending on the state of the chosen line and event only the possible functionality will be enabled and the rest disabled. For example if there is no previous fault on the specific line the only available function would be to add a fault. Changing when a fault ends should also be possible in the case a fault is ended by mistake. One possibility would be to implement this function within the edit fault dialog, for instance one could there choose which event is connected to the solution of the fault.

Changing the current visualisation of the faults will make it clearer when certain faults start and when they end. The proposed new visualisation can be seen in Figure 7.6. The old view is shown in Figure 6.1.

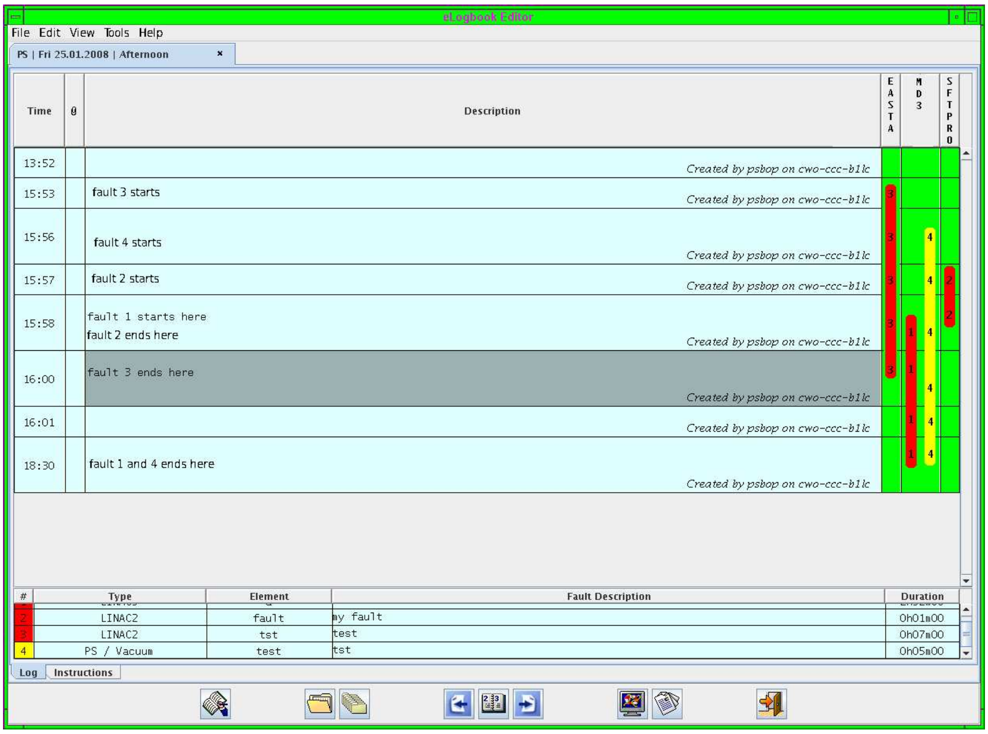

Figure 7.6: New visualisation of fault duration

7.1.5 Menu Structure

The current menu structure causes problems for the user. The problems are due to the fact that a big part of the functionality of the application cannot be found in the menus and can therefore not be found easily. Currently the menu-items are sorted under the menu-titles Log, View, Tools and "Font Size". Replacing these titles with standard titles would keep the application coherent with other well known applications. The proposed titles and corresponding functions are illustrated in Figure 7.7. The new structure is derived by removing unnecessary

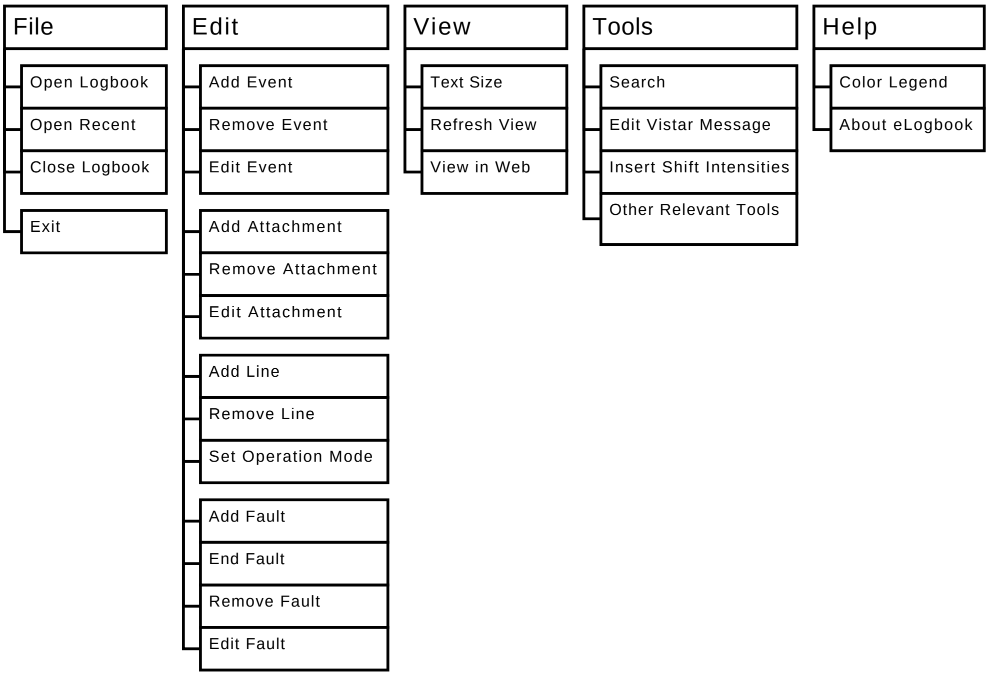

Figure 7.7: Proposed new menu structure

functions, renaming functions and regrouping the functions under standard menu headers.

7.1.6 Search Utility

Some problems were found in the search utility. For the java client users the main obstacle is that they are forced to open a web browser in order to search for entries. Implementing search functionality into the java client should be considered. If the search is not implemented in the java-client, there should at least be a link to the search web-interface in the java-client menus.

The search utility implemented as a web-page has some fundamental problems in itself. There should be different fields for specifying the search. Such fields as keywords, logbook, date and author should be implemented. The search is quite slow and would be worth improving. If the duration before the system responds is over 5 seconds the user should be informed, for example by showing a progress bar.

The look and feel of the search utility and the presentation of the results is significantly different from the appearance of the java and web-client, if these interfaces would be consolidated the user would better understand that the interfaces are related to each other.

7.1.7 Improvements for the Web-interface

The web-interface of the CCC eLogbook was solely evaluated with the heuristic evaluation method. The following proposals are therefore of a more generic sort and mainly encourages the use of standard interaction elements and following heuristic rules.

The look and feel of the web-interface should be consolidated with the java-client interface. In this way users who are used to the java-client will find it easier to use the web version. This can be accomplished by using similar colour schemes and using the same layout for the logbooks.

The current web-interface has problems with the interaction widgets. Drop-down menus are hidden in the interface and can be hard for the user to find. Instead of trying to implement new drop-down menus it would be worth using standard widgets. For the interaction needed in the interface normal links or buttons should be sufficient.

7.2 New Functionality for the Electronic Logbook

The contextual inquiry and the literature review revealed some new functionality which would be worth integrating into electronic logbooks. The first two issues are connected to the problematics with the keyboard and mouse as the single input device. The third is an approach to make the information in the logbook better usable when operators run into problems which have been encountered before. The fourth and last improvement is simpler and concerns linking information about operators with their logbook entries.

7.2.1 Making Hand-drawn Entries

Hand-drawn sketches and calculations are frequently made on pieces of paper and in personal paper logbooks. They are however seldom reported in the logbooks. Enabling hand-drawn entries in the logbooks would benefit the users. Different solutions for hand-drawn entries are available, ranging from scanning the notes to using digital pens as described in chapter 2.

7.2.2 Mathematical Formulae Editor

In order to enter mathematical formulae in the currently used logbooks the user must first create an image of the formula with an external editor. Integrating a mathematical formulae editor into the logbook would make it easier for users to insert such entries into the logbook.

7.2.3 Adding Guidance to Logbook

Enriching the logbook by providing guidance to the operator should help to make the entries more valuable. Often the solutions of problems reported in the logbook is simply "problem solved" or "beam is back". If the operator would be encouraged to write an entry containing screen-shots and explanations as to how the problem was solved the logbook history would be of better help during future equipment problems.

7.2.4 Contact Information Integration

Knowing who made entries in the current eLogbook can be hard to find out. By adding some sort of log-in it would be possible to identify who is making the entries and therefore directly link the entry signature to for example the CERN phone-book page containing the authors contact information. This way when trying to figure out what has been done it is easy to find the person who was previously working with the problem.

7.2.5 Standardized Event Output

It was revealed that some of the collaborators has a need to combine different logbooks in a fashion to oversee how different groups of the collaboration work and progress with their machine. For example the ATLAS control room operators might want to be able to collect and view logbook entries made by TI concerning work which will affect ATLAS and entries made by LHC operators about how problems with the beam is being handled. However not all groups desire to use the same logbook application. Some may prefer a web-solution, other a java-application and someone yet another solution. In order to allow users to extract entries of interest and combine them into a summarizing view some sort of standardized event output format would be needed. One possibility would be having all logbooks generate a RSS-feed with documented fields on base of which users could create mash-ups using entries of specific interest.

7.2.6 Personal digital pen logbooks

Having scientists working on collaborative experiments using their own personal logbooks for personal notes is not optimal. These notes may contain important information, and if the scientist in question is not available, his notes will neither be.

The problem with the digital pen logbook discussed in section 5.2.2 was with integrating it with the ATLOG. The digital pen logbook has been working fine when used by individuals.

One solution would be to provide the scientists working on an experiment with digital pen logbooks for personal notes. The resulting data from the digital pen logbooks could be stored and linked to the official electronic logbook. This way all data would be available on-line and stored centrally.

This still has the problem that the digital pen notes are not efficiently searchable due to problems with hand-writing recognition. However this way notes made during the same period of time as events in the official electronic logbook could be fetched according to timestamps.

8 Conclusion

The goal of this study was to evaluate the current usability situation of electronic logbooks used within CERN experiments. The study concentrated on the logbooks used by CCC and ATLAS. Doing a literature review clarified what is currently being done in the field. Through conducting a contextual study new insight was made into the development of current electronic logbooks and about how they satisfy the user's needs and how sometime they fail. The usability evaluation revealed the current state of usability in the eLogbook.

8.1 Current Development

As discussed in chapter 2, usability is said to be taken into account in many reports on the development of electronic logbooks. However no reports on the actual usability work was found. This study revealed several usability problems in the CCC eLogbook during the usability evaluation as described in chapter 6. Doing iterative usability evaluation on the logbook software would further improve the interface.

Using operators as developers speeds up the feedback process from users as they are colleagues of the developers. The operator-developers also have good knowledge of the field for which the software is being developed. This combination leads to interesting new solutions. At the same time this leads to problems, the operators are seldom usability experts and constant requirements from colleagues easily lead to ad-hoc development where functionality is added to the software whenever someone asks for it. The resulting interface being cluttered of overlapping functionality and hidden short-cuts.

During the contextual inquiries the users were also observed using other day to day software aside from the logbook. The software is made for a small domain and the users have specific knowledge of the field and therefore the software might seem even harder to use to a bystander. However it seems like this small niche has fallen outside of the wake of usability as the user-interfaces are cluttered with buttons, menus, information screens etc. All of which probably is not needed at once by the user or, even less, possible to comprehend at once. Doing usability evaluations on these interface would most probably improve the learning curve of the software drastically. Currently it seems like it might be quite a barrier for new operators to learn the software.

8.2 Impact of Electronic Logbooks

Since moving from traditional paper logbooks to electronic logbooks there has been a shift in the detail of the entries. In the paper logbook users made small entries and recorded thoughts about what is going on. It was always easy to enter some new small notes and add detail as the user worked on with the experiment. Now in the digital age many of these small notes never make it to the digital logbooks. The result is a much coarser record of the experiment. Still the electronic logbooks provides ease of sharing and searching the entries, but it is hard to see how much information is lost.

The transition from paper to electronic logbooks has been enforced from the management level mainly due to requirements for sharing logbook data and making it searchable. Attention has also been given to having all logbook data gathered in one location. Electronic logbooks have been developed and installed. Users have been encouraged to use them and they have been adopted to a certain point. However the users also make notes into paper logbook so the transition is not total. Finding a solution that would get the information from the personal logbooks into the electronic record would be essential.

8.3 ATLAS and CCC Electronic Logbooks

The fact that paper logbooks are still used alongside with the electronic logbook is a clear indication that the electronic logbooks does not completely answer the needs of the scientists using them. The electronic logbooks resolve the issue of instantly sharing important information over a distributed medium and providing search functionality.

Some functionality previously possible in paper logbooks is no longer available in the electronic logbooks inspected in this thesis. The possibility to annotate entries and make sketches and drawings is missing. The biggest issue however is the threshold for making entries.

The usability of eLogbook is on a acceptable level, since it is only used by a group of users who can personally get help from the developer whenever they run into problems. However the interface could easily be improved. Many issues where found in the usability evaluation. Taking these issues into account in future development cycles will improve the user interface. Improving the usability of the application would lower the threshold for making entries. This would lead to a more detailed record in the logbook.

8.4 Future of Logbooks

Integrating new features into the digital logbook might enrich the input. Through different means we will get a more detailed record of the experiments. However it seems like an impossible task to gain the same level of detail as previously recorded in the paper logbooks. Using a digital pen logbook solution side by side with normal electronic logbooks as discussed in section 7.2.6 might be a worthwhile solution. Still reaching the goal of searchable content cannot be met with this approach. In this time of change from analog to digital media this might be an ample compromise.

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APPENDIX 1: Background Questionnaire

1. What is your profession/work description?
2. Which project/experiment/accelerator are you working for?
3. How long have you been working in your current position?
4. Are you using any electronic logbook? Which?
5. How long have you been using the electronic logbook in question?
6. Do you keep a paper logbook? Is it for personal notes or related to your ongoing experiment?
7. How frequently do you read entries from your electronic and/or paper logbook?
8. How frequently do you make entries into your electronic and/or paper logbook?
9. What kind of information do you search for when browsing electronic and/or paper logbooks?
10. Which are the five (5) most common type of entries you make in the electronic and/or paper logbook?
11. Describe the reason for making these entries and how you go through with making them

12. If you use both electronic and paper logbooks, why do you need the paper logbook?

APPENDIX 2: List of Heuristic Problems

The heuristic evaluation of the eLogbook was first separated into two different parts; the web-interface and the java-interface. By making affinity diagrams the problems were arranged into comprehensible groups. The severity of the problems ws graded on a scale from 1-5.

The following heuristics were used:

1. simple and natural dialog
2. speak the users language
3. minimize the users memory payload
4. be consistent
5. provide feedback
6. provide clearly marked exits
7. provide shortcuts
8. provide good error messages
9. error prevention
10. help and documentation

The severity of the problems was graded on a scale from 1-5:

1: cosmetic

2: major

3: minor

4: annoyances

5: critical

Java Client Interface

Dialogs

problem number	problem explanation	severity:	heuristics:
1	edit attachment: missing save changes, cancel buttons	5	1, 2, 6, 9
2	edit attachment: delete file, no confirmation or possibility to cancel	5	6,9
3	when removing instruction no confirmation dialog is shown	5	9
4	no way to view attachment, only edit attachment, image could be shown under event description?	4	1, 3, 4, 5
5	edit attachment: window capture -> captured image dialog comes after edit attachment dialog is closed	3	1,3
6	add lines dialog: click to change value not 'eye-catching' goes unnoticed, could use radio button since only 3 options	3	1,9
7	add lines function: operation mode should use default widget for choosing value	3	1,4
8	main page message: buttons read& write. suggestion: old message in uneditable field; new message in other field. buttons update save, cancel	3	1, 2, 4, 9
9	set operation mode, current mode should be preselected	2	1,3
10	add lines: after adding line it disappears from list when adding more, if shown as disabled user will know that it has already been added	2	5

Area

problem number	problem explanation	severity:	heuristics:
11	right click: must first choose event with left click before applying right click to work; if add lines not remove event	4	1, 3, 4, 7
12	right click should activate cell and open menu, ie. current left+right click	4	1, 3, 4
13	faults are numbered and placed above each other, would be easier to read if beside each other so that corresponding numbers would align under each other	4	1,3
14	fault number is no longer shown in the entry where the fault is resolved, should continue into this entry	4	1,4
15	font size only applies to entry font size, not to interface elements	3	1,4

16	events are recorded with author, ex. cpsop on cwo-ccc-b81c; could it be possible to choose user so you could identify who made the entry by name automatically; view could contain link to persons contact details: phone & email	3	2,7
17	shortcut for adding entry is only possible through clicking on previous entry, not below on grey area	2	1, 3, 5
18	consigne and instruction used for same thing: change to instruction	2	1, 2, 4
19	java: color legend for lines not explained other than when adding new line	2	1,3
20	while viewing instructions the color legend looks like buttons not like legend	2	4,1
21	icon for web view not intuitive	2	1, 2, 3
22	vistar is called main page message?	2	1, 2, 3
23	instruction does not show author or time of instruction made	2	3,7
24	help-menu aligned to the right, should be aligned to the left, next to the previous menu	1	1
25	add event dialog title is edit event	1	1,2
26	only button for add new entry, not add entry with fault, add entry end fault, add line, add fault, end fault	1	4
27	legend: now shift = current shift	1	2
28	click on gray should unselect selected field	1	1

Menu

problem number	problem explanation	severity:	heuristics:
29	add fault; only through right click	5	1,4
30	entries can only be removed through right click on entry, function not found through the “menu”	5	3,4
31	add lines function can only be reached through right click on specific event, should also be reached through the menu	5	3,4
32	java: add event with fault only by right click on lines, should also be able through right click anywhere and in menu	4	4
33	log menu: not all are logically under log: new event: open last, open: goto next, goto, goto previous; print; close editor, should use default name for menu: File, Edit, View, Insert...	4	1, 3, 4
34	tools>application launcher> different name more appropriate? get entry from external source?	3	1,2

35	close editor-item in log-menu. should be called exit as per norm	2	1, 6, 9
36	print: what happens?	2	5,6

Functions

problem number	problem explanation	severity:	heuristics:
37	fault cannot be removed.	5	1,6
38	fault start, end time cannot be extrapolated	4	6,9
39	lines: no way of removing lines after adding line only through setting operations mode to no operation for all entries for line to be removed	4	1, 2, 6
40	line removed by setting set operation mode to unselected line; should have remove line option	4	1, 2, 4, 7
41	no remove fault option	4	6
42	right click could give option to add fault end event	2	4,7
43	cannot make comments in java client, possible in web interface	1	4

Web-interface

Layout

problem number	problem explanation	severity:	heuristics:
44	no hint of where the add entry menu is	5	1
45	add shift button unnoticable	3	1,3
46	search layout should be consistent with web-elogbook, now looks like a different site	3	1,4
47	calendar icon unnoticable	2	1
48	Phones: phone numbers instead or contact	1	2,7
49	stop sign showing no more later/earlier shifts look scary, grayed arrow would be appropriate, alt text = no more shifts	1	1
50	web interface entries numbered, not of interest for user	1	1

Consistency

problem number	problem explanation	severity:	heuristics:
51	a lot of functionality missing from the web interface, compared to the java interface	5	
52	web interface: only one class of faults, not distinguished between fault and warning	3	4
53	details of attachment not shown in web interface	3	4
54	changing shift arrows should work in same way in both interfaces: calendar in middle	3	4
55	web interface, lines and faults not in same place as in java	2	4
56	comment in web, description in java	2	2,4
57	consignes not found in the same location as in java	2	2,4
58	“consignes” french, instructions?	2	2,4
59	what does messenger do?	2	2, 5, 10

Structure

problem number	problem explanation	severity:	heuristics:
60	bad menues, hard to use: eLogbooks>PS>...	5	1,9
61	links in top menues badly organized	5	1,4
62	search should include different fields for different entries: ex. machine, author, date, keyword, etc.	4	1, 2, 3, 7, 9
63	arrangement of links in top menu: different lelvels of logical hierarchy on same level in interface	4	1,4
64	statistic and dump elogbook are so slow it should show some kind of indicator of how long it will take to complete the request, and possibility to cancel command	3	5,6
65	dump elogbook is connected to current log but grouped with external links	3	1,4
66	others>video vister connected to current logbook, should not be in external links	3	1,4
67	logout link in top row, should be close to information about login at bottom	3	1,4
68	startpage of each log is current shift even if shift is empty, consistency with java would suggest opening last shift with events	1	4

APPENDIX 3: User Test Tasks

1. Open the PS logbook with the java client
2. Read instructions left by previous shift operator
3. Start the current shift
4. Enter your name as a new entry in the PS logbook
5. Insert shift intensities into the logbook
6. John Doe calls and tells you there is no beam in the Antiproton Decelerator, make a new entry in the logbook reporting the fault.
7. Report the problem on the vistar; "There is no beam in AD, we are working on it"
8. Search for last entry in logbook about AD, when was it?
9. Add an attachment to the previous fault description (screen-capture).
10. Another fault appears in EASTC, insert the fault into the logbook
11. You have solved the fault in AD informed by John Doe by resetting equipment DR.SMI5306 enter the solution into the logbook and end the fault
12. Add an attachment to the solution of the problem (image\user\cpsop\solution.png).
13. The fault in EASTC remains unsolved when your shift ends, make an entry into the logbook about who you called in order to solve the fault (you called Frank and he said he would look into it)

14. Leave instructions for following shift about the ongoing user tests: "User tests on the eLogbook using the PS logbook will continue until 13.3.2008"